Census of terns and other colonial waterbirds along the Gulf of St. Lawrence coast of New Brunswick - 2000

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Atlantic Region 2002
Canadian Wildlife Service
Environment Conservation Branch

Technical Report Series Number 397

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103-05049/

CENSUS OF TERNS AND OTHER COLONIAL WATERBIRDS ALONG THE GULF OF ST. LAWRENCE COAST OF NEW BRUNSWICK - 2000

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Canadian Wildlife Service Technical Report Series No. 397

This report may be cited as:

Boyne, A. W. and J. K. Hudson. 2002. Census of terns and other colonial waterbirds along the Gulf of St. Lawrence coast of New Brunswick - 2000. Technical Report Series No. 397. Canadian Wildlife Service, Atlantic Region. 29 pp.

Published under the Authority of the
Minister of Environment
Canadian Wildlife Service

© Minister of Supply and Services Canada 2002
Catalogue No.: CW69-5/397E
ISBN: 0-662-33234-2

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SUMMARY

Colonial waterbird colonies were identified during an aerial survey of the Gulf of St. Lawrence coast of New Brunswick, 31 May and 1 June, 2000. Common Tern colonies were subsequently visited by ground to obtain nest counts, while aerial photography was used to conduct counts of gull, cormorant and heron colonies.

A total of 12 618 Common Tern nests were counted at 11 colonies. A twelfth colony identified during aerial surveys was not surveyed by ground. The Common Tern population along this coast has become concentrated into half as many colonies as were identified in 1983, and the regional breeding population has declined. Tern Island in Kouchibouguac National Park is the only managed tern colony along this coast and it has increased from 6396 pairs in 1983 to 6911 pairs in 2000. Outside the National Park the population has declined from 9104 pairs at 23 sites in 1983 to 5707 pairs at 11 sites in 2000.

An estimated 3565 pairs of Ring-billed Gulls nested at seven sites in New Brunswick in 2000. This is more than double the number censused in 1986 (1534 pairs). Virtually the entire increase can be accounted for by a single colony, Tracadie Bar, which grew from 115 nests in 1986 to 2109 nests in 2000. The number of Great Black-backed Gulls has not changed substantially since 1986, with a breeding population of about 900 pairs, but less than half the number of Herring Gulls bred along the Gulf of St. Lawrence coast of New Brunswick in 2000 compared to 1986. In 1986, it was estimated that almost 6000 pairs of Herring Gulls nested in the region while our estimate was just over 2200 pairs in 2000.

Black-legged Kittiwakes were confirmed to nest along the New Brunswick coast of the Gulf of St. Lawrence for the first time. A colony of 97 pairs was found nesting amongst a small colony of Double-crested Cormorants near Grindstone Point in northern New Brunswick.

Double-crested Cormorants were observed nesting at nine sites. We estimated that 3704 pairs of cormorants nested at these colonies, however our estimate for one site, Heron Island, is questionable because aerial photography is an inexact method of surveying tree-nesting cormorants. In 1986, it was estimated that approximately 4000 pairs of Double-crested Cormorants nested in the region, half of which were thought to nest on Heron Island. The 1986 estimate for Heron Island is also questionable, which makes it difficult to determine the population trend for the species. Although, prior to our survey, the species was only known to breed at five sites along this coast, and if Heron Island is excluded from the analysis, the population has increased.

Great Blue Heron colonies were identified at six sites, with an estimated 647 pairs. We only surveyed coastal areas and undoubtedly missed estuarine and inland colonies. Despite the incomplete coverage, our estimate from this survey is higher than the 500 pairs that were estimated to nest along this coast in 1980.

INTRODUCTION

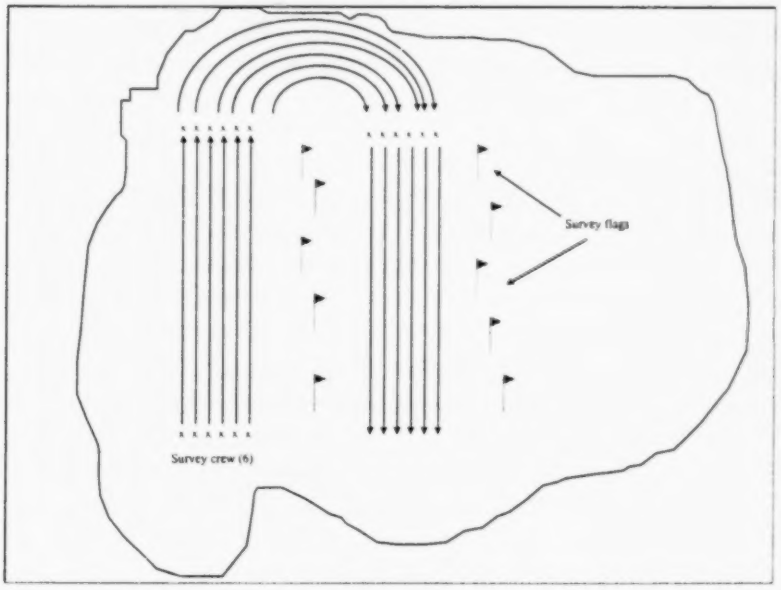
The Gulf of St. Lawrence coast of New Brunswick supports the largest concentration of breeding Common Terns (*Sterna hirundo*) in Atlantic Canada. The largest colony, located in Kouchibouguac National Park, was at one time the largest tern colony on the Atlantic coast of North America. The only comprehensive survey for terns along this coast was conducted in 1983 (Lock et al. 1984). During these surveys, Lock estimated that 15 500 pairs of Common Terns attempted to nest at 26 locations. Individual sites have been revisited in the years since and several were found to have been abandoned by nesting terns (C. MacKinnon, Canadian Wildlife Service - Atlantic Region, unpublished data). Prior to the survey outlined in this report, it was unclear whether these colonies had moved to nearby sites, the population had declined, or whether a combination of the two factors was occurring. Studies in Kouchibouguac National Park showed that colonizing Great Black-backed Gulls (*Larus marinus*) and Herring Gulls (*L. argentatus*) had a negative impact on terns nesting in the Park (Poussart et al. 1997). In recent years, increasing populations of Ring-billed Gulls (*L. delawarensis*) were also thought to be a potential threat to terns. Several colonies on the Acadian Peninsula were increasing at sites where the species nest together (R. Chiasson, personal communication), and Ring-billed Gulls are known to exclude terns from nesting areas (Blokpoel et al. 1997). Increased development along New Brunswick's coast, islands, and barrier beaches further adds to the concern for terns and other colonial waterbirds that rely on these habitats during the breeding season.

The timing and the methodology of this survey were designed to census Common Terns, although counts were also made of breeding Ring-billed Gulls, Great Black-backed Gulls, Herring Gulls, Black-legged Kittiwakes (*Rissa tridactyla*), Double-crested Cormorants (*Phalacrocorax auritus*), and Great Blue Herons (*Ardea herodias*).

METHODS

An aerial survey of the Gulf of St. Lawrence coast of New Brunswick from Baie Verte (N 46.003°, W 64.065°) to Dalhousie (N 48.070°, W 66.387°) was conducted 31 May and 1 June, 2000 (CWS Coastal Blocks 331-362 [Hicklin and Barrow 1996]; Figure 1). Two observers (AWB and JKH) conducted the survey from a Cessna 172 (Moncton Flight College; pilot: Marc Boucher) flying at 500 feet or less at 80-100 knots. Bird colonies were identified from the air, and their location marked on a 1:250,000 topographic map. In addition, aerial photographs were taken of gull, cormorant, and heron colonies from an altitude of 500-800 feet using a Pentax 6 x 7 medium format camera with Kodak TMX 120 black and white professional film. Photographs were taken from the front right hand seat, through the opened side window of the plane. Vertical photos (90° straight down) were not possible because the permanent landing gear on a Cessna 172 interferes with the view, so the angle at which the photos were taken varied with the height of the aircraft (i.e. the lower the plane the greater the angle).

Tern colonies were subsequently visited by a survey crew to attain nest counts. Ground surveys were conducted 6-20 June, 2000. Typically tern surveys should be conducted during the last week of incubation. In Kouchibouguac National Park hatching typically occurs around the second week of July (Poussart et al. 1997). Thus some early surveys may have been conducted prior to the completion of laying (see RESULTS AND DISCUSSION). Surveys were conducted by 2-8 people walking transects through the colony. The surveyors walked parallel transects about arms length apart. The outside line of each transect was marked with forestry survey flags, which were picked up on the following transect (see below). Ground surveys were coordinated by the authors at all sites except Crab Island, where Roland Chiasson and Sabine Dietz (New Brunswick Federation of Naturalists, Piper Project) coordinated surveys, and Tern Island, KNP where surveys were coordinated by Parks Canada staff (Eric Tremblay, KNP, personal communication).



Pattern of ground surveys

Nest counts were obtained for a few Ring-billed Gull colonies during ground surveys for terns. Surveys were conducted after peak hatch for Herring and Great Black-backed Gulls so ground surveys were not attempted for these species.

Aerial photographs of gull, cormorant and heron colonies, were interpreted digitally. Negatives were scanned to Pro-CDs at a resolution of 6144 x 4096 pixels and analyses were performed using Adobe Photoshop® 5.5. In cases where multiple photos were required to cover an entire colony, two methods were used to account for overlap in the photos. Initially, lines were drawn in Photoshop directly on each image to identify areas that had been previously counted on adjacent images (Figure 2). Later we digitally "patched" several images together to create a single composite image of the entire colony (Figure 3). This latter technique was initially more labourious but facilitated the identification of overlaps between photos.

The size of cormorant and heron nests made it possible to identify *apparently occupied nest-sites* (Bibby et al. 1992), however for gulls it was only possible to identify birds that appeared to be occupying a territory (*territorial individuals*). Gulls that were on the edge

of the colony, obviously loafing, or in the intertidal zone were not included in the count, and birds that, based on proximity, appeared to be paired were only counted once. Birds on the interior of the colony that were spaced regularly were considered *territorial individuals* and were assumed to be tending a nest. Apparently occupied nest-sites of Black-legged Kittiwakes were identified on aerial photos by the presence of a bird on a cliff ledge covered with white feces. In Photoshop, a transparent layer was added over the images for each species and using the pencil tool a square mark, with a known number of pixels (eg. three pixels x three pixels), was placed on each *apparently occupied nest-site* (cormorants, herons, and kittiwakes) or *territorial individual* (gulls). The number of pixels in each mark was consistent within an image but varied between images depending on the level of zoom that was optimal to identify targets. The HISTOGRAM function in Photoshop was used to count the number of pixels on each layer. To determine the number of *apparently occupied nest-sites* or *territorial individuals*, the total number of pixels was simply divided by the number of pixels in each square.

RESULTS AND DISCUSSION

Common Terns

Common Terns were confirmed breeding at 11 sites, and may have bred at a twelfth (Table 1; Figure 4). Aerial surveys identified potential tern colonies at 13 sites (Table 1). Twelve of these sites, plus an additional three sites were subsequently surveyed by ground (Table 2). McAlmon Island was identified as a potential colony during the aerial survey but a subsequent ground survey to confirm breeding was not conducted. The additional three sites were visited because of recent records of nesting terns. Ground surveys confirmed breeding terns at eight of the 12 sites identified during the aerial survey and visited by ground, and at all three additional sites (Table 1). At two sites (south of Hay Island and near Cap Brule) that were initially identified as tern colonies, non-breeding Bonaparte's Gulls (*L. philadelphia*) were observed during the ground surveys and may have been misidentified from the air. At two other sites (Cocagne Cove and Heron Island), no terns were observed, breeding or otherwise. Ground surveys at these two sites occurred 15 and 19 days after the aerial survey so colonies may have been abandoned by then.

A total of 12 618 tern nests were counted at 11 colonies (Table 2). The largest colony was on Tern Island, Kouchibouguac National Park (KNP), which supported 6911 pairs. Tern Island in Tabusintac Bay (Tern Island, Tabusintac) was the only other colony with more than 1000 nests (2607 nests), although four other colonies had more than 500 nests (Table 2). Mean clutch size ranged between 1.50 - 2.66 (Table 2). No Arctic Terns (*S. paradisaea*) were observed, although minimal effort was spent trying to locate this species as only the occasional pair nests along this coast, amongst the far more numerous Common Terns.

In 1983, 12 461 Common Tern nests were counted at 26 colonies (Lock et al. 1984). Lock et al. (1984) felt this was an underestimate because at two sites there were large

proportions of empty nests. They corrected for this based on the ratio ot occupied nests to empty nests observed at the other colonies and estimated the Common Tern population along the Gulf of St. Lawrence coast of New Brunswick to be 15 500 pairs. The total number of nests (12 618) in 2000 is similar to the number of uncorrected nests counted in 1983, but about 3 000 lower than the corrected estimate.

Fox Dens Beach and Tern Island, Tabusintac were surveyed 8 and 9 June respectively, whereas no other colony with more than two pairs of terns was surveyed until 18 June. Compared to sites surveyed after 17 June, the mean clutch size was much lower and the proportion of empty nests was higher at Fox Dens Beach (Table 2). The mean clutch size at Tern Island, Tabusintac was more typical, however there were still a large number of empty nests (Table 2). These two early surveys may have occurred prior to the completion of peak laying. If the proportion of empty nests at sites surveyed after 17 June (0.1 8) is applied to these two early surveys, Fox Dens Beach would have supported an additional 301 nests and Tern Island, Tabusintac would have had an additional 183 nests. These additional 484 nests would have increased the population estimate of terns along this coast to 13 102 pairs, still less than the 1983 estimate of 15 500..

The number of breeding terns may have decreased but what is most alarming is the decrease in the number of colonies, particularly south of Kouchibouguac National Park, where in 2000 there were only two colonies, likely supporting less than 25 pairs, compared to six colonies supporting over 300 pairs in 1983 (Lock et al. 1984). Terns are concentrated into fewer large colonies, of which the two largest are still Tern Island, KNP and Tern Island, Tabusintac. Tern Island, KNP is the only managed tern colony along this stretch of coast and it has increased from 6396 pairs in 1983 (Lock et al. 1984) to 6911 pairs in 2000. Outside the National Park the number of colonies has been reduced to 11, and the population has declined from 9104 pairs at 23 sites in 1983 to 5707 pairs at 11 sites in 2000. Even if the corrected totals for Fox Dens Beach and Tern Island, Tabusintac are included (6191 pairs), the population outside the park would still show a drastic decline. Were it not for the management of the National Park the regional population of terns would likely be in much worse shape.

Ring-billed Gulls

Ring-billed Gulls nested at seven sites in New Brunswick in 2000 (Table 3; Figure 5). Five of these sites were identified during aerial surveys, with estimates made via aerial photo interpretation and two smaller colonies (>25 nests) were discovered and surveyed while conducting ground surveys at tern colonies. Colonies ranged in size from six nests in Bathurst Harbour to 2109 nests at Tracadie Bar. Fox Dens Beach was the only colony identified from the air that was also surveyed on the ground. The estimate from the aerial photo interpretation was 311 territorial individuals, compared to 262 nests on the ground (Table 3). The overestimation of gulls from aerial photography is not unexpected (Lock 1987a). Lock's estimates ranged from 1.26 - 2.12 individuals from the air for each nest observed on the ground. For Fox Dens Beach our aerial estimate was 1.19 individuals from the air for each nest on the ground. Our aerial photo estimates likely overestimated

the population at other sites as well. The mean clutch size of Ring-billed Gull nests at the three colonies that were surveyed on the ground was 2.49 ± 0.78 (Table 4).

The number of Ring-billed Gulls nesting in New Brunswick has doubled since 1986 (Lock 1987a). Virtually the entire increase can be accounted for by the colony on Tracadie Bar which grew from 115 nests in 1986 to 2109 nests in 2000 (Table 3), a mean annual rate of increase of 23%. Overall, the population along this coast had an annual population growth of 6.2% between 1986 - 2000. This rate is much lower than the 21% annual increase observed for Ring-billed Gulls throughout the Maritime Provinces between the early 1970s and late 1980s (Lock 1988). The species was first identified nesting in the Maritimes in 1965, when 9 nests were discovered on an island in Bathurst Harbour (H. Chaisson, Maritime Nest Record Scheme, Canadian Wildlife Service, Sackville, N.B.). In 1986 the species was known from six sites in New Brunswick, however only three of these sites supported nesting Ring-billed Gulls in 2000. The number of Ring-billed Gulls nesting in Prince Edward Island also doubled during this time period; from 230 pairs in 1986 (Lock 1987b) to 497 pairs in 1999 (Boyne et al. 2001). Despite these increases, the range of Ring-billed Gulls does not appear to be expanding in the Maritimes as the population in New Brunswick is still restricted to colonies north of Miramichi Bay, and the species is only known from four sites in PEI, of which only two have been occupied since 1984. Despite increasing numbers of observations of birds outside the breeding season (Erskine 1993), the species has not been recorded breeding in Nova Scotia (Boyne and Beukens *in prep*).

Great Black-backed Gulls and Herring Gulls

Great Black-backed Gulls and Herring Gulls were identified nesting at 12 and 11 sites in northern New Brunswick, respectively (Figures 6 and 7). Aerial photo interpretation identified 910 territorial Great Black-backed Gulls, 2330 territorial Herring Gulls, and 237 territorial individuals at two sites (Bathurst Harbour islands 1 and 3) that could not be identified to species because of poor quality photos (Table 5).

Typically, estimates of nesting gulls made from aerial photos are corrected by conducting ground surveys at a subset of colonies to determine the ratio of territorial individuals identified on aerial photos to actual nests observed during ground counts (Kadlec and Drury 1968). In this study ground surveys were not conducted because they would have occurred after peak hatch and caused too much disturbance. Thus we did not calculate a correction factor. In 1986, the ratio of aerial estimates to ground counts varied greatly between islands (0.14 - 5.95 for GBBG; 0.13 - 14.9 for HERG; Lock 1987a). He suggested that difficulties speciating gull nests during ground counts and incomplete coverage of some colonies during these counts likely contributed to the large variation in the ratios. To estimate the population size, Lock (1987a) used ground counts where they existed and corrected aerial estimates using the ratio 1.1 territorial individuals per nest taken from Kadlec and Drury (1968). A recent study by Mawhinney et al. (1999) calculated ratios of 2.58 for Great Black-backed Gulls and 1.91 for Herring Gulls in the Bay of Fundy, while the ratios in a similar study in Maine calculated ratios of 0.75 and 1.16 for Great Black-backed Gulls and Herring Gulls, respectively (Shauffler 1998). Thus

the practice of adopting a correction factor from other studies is tenuous at best. The ratio is undoubtedly affected by habitat/vegetation type (Mawhinney et al. 1999), ability to differentiate between Great Black-backed and Herring Gull nests during ground counts (Lock 1987a), and the timing of surveys (see Johnson and Krohn 2001).

Using the method mentioned above, Lock (1987a) estimated there to be 5950 pairs of Herring Gulls (19 colonies), and 1134 pairs of Great Black-backed Gulls (17 colonies) in northern New Brunswick in 1986. If we used the ratio of 1.1 territorial individuals from the air for every nest observed during ground counts (Kadlec and Drury 1968), and assumed that the ratio of Herring Gulls to Great Black-backed Gulls (2.5 HERG: 1 GBBG) for known nests was the same for the 237 unknown nests (169 HERG and 68 GBBG), our estimates would be 2272 pairs of Herring Gulls and 889 Great Black-backed Gulls nesting along the Gulf of St. Lawrence coast of New Brunswick in 2000.

Ignoring the differences in methodologies between the 1986 survey and our survey, it appears that the number of Great Black-backed Gulls has not changed substantially since 1986, but only half the number of Herring Gulls are breeding along the Gulf of St. Lawrence coast of New Brunswick in 2000 compared to 1986.

Black-legged Kittiwakes

Black-legged Kittiwakes were identified nesting on cliffs east of Grindstone Point (N 47.758°, W 65.339°) amongst a colony of Double-crested Cormorants (Figure 8). This is the first nesting record for this species in northern New Brunswick. Ninety-seven apparently occupied nest-sites were identified from aerial photos. The presence of the colony was confirmed with a ground visit on 7 June, although inclement weather prevented an accurate estimate of breeding birds during this trip. The discovery of this colony is not that unexpected as kittiwakes nest along the south shore of the Gaspé Peninsula in Quebec, approximately 30 km across the Bay of Chaleur. During the visit on 7 June six Black Guillemots (*Cepphus grylle*) were flushed from the cliffs, although breeding could not be confirmed.

Double-crested Cormorants

Cormorant colonies were identified and photographed at nine sites during the aerial survey (Table 6; Figure 9). Two distinct sub-colonies on Heron Island are considered a single site but are reported separately. We estimated that 3704 pairs (apparently occupied nest-sites) of Double-crested Cormorants nested along this coast. However, it is likely that this is an underestimate, as pairs in tree-nesting colonies are difficult to detect on aerial photos because each tree can support multiple nests at differing heights (Boyne et al. 2001, Lock 1987a). Heron Island and Fleming Island were the only tree-nesting colonies (Table 6), but only Heron Island would have been substantially underestimated, as Fleming Island only supported 14 pair. Any underestimation of Heron Island would affect the regional estimate because this site was thought to support half of this coast's nesting cormorants in 1986 (Lock 1987a).

This survey was not designed to detect nesting cormorants, however comparisons to previous data suggest that our coverage for this species was quite complete. Prior to this survey, only five historic nesting sites along this section of coastline were listed in the Atlantic Region Seabird Colony Database (Canadian Wildlife Service, Sackville, NB), and in 1986, Lock (1987a) only identified four colonies. All known sites were surveyed and four new sites were identified.

In 1986, Lock (1987a) estimated that approximately 4000 pairs of Double-crested Cormorants nested in northern New Brunswick. Over half of these were thought to nest on Heron Island but the estimate for this colony was made visually during an overflight and is likely inaccurate (see Lock 1987a). The trend at the other four historic nest sites vary; Pokeshaw Island is decreasing, Egg Island and Bon Amy Rocks are increasing, and Fleming Island is stable, although it only supports 14 nesting pairs (Figure 11). The decline in the colony on Pokeshaw Island may be explained by birds dispersing to nearby sites as all four new sites are located along the Bay of Chaleur; three within 10 km of Pokeshaw Island. The four new sites account for 1221 of the estimated 3704 nesting pairs.

The difficulties with estimating the number of cormorants nesting at Heron Island prohibits any conclusions with respect to the trend of Double-crested Cormorants in northern New Brunswick, although it should be noted that outside of Heron Island, the regional population has both increased in number and distribution.

Great Blue Herons

The Atlantic Region Seabird Colony Database lists 18 sites where Great Blue Herons have nested since 1975, although only 12 have supported more than 20 pairs. Of the six sites that have supported less than 20 nesting pairs, only one has a survey record since 1981 (Pointe-à-Bouleau 1991: 20 pairs). Six of the 12 sites that have supported more than 20 pairs have no colony records since 1981, leaving six sites with records of more than 20 pairs of herons in the last 20 years. Five of these sites were surveyed during our survey, and the sixth was surveyed during a ground census in 1998 (C. MacKinnon, unpublished data).

Unlike tree-nesting cormorants, Great Blue Herons typically nest at the tops of trees making their nests more easy to identify on aerial photographs. Five heronries were observed during the aerial survey, supporting an estimated 455 pairs (apparently occupied nest-sites) of Great Blue Herons (Table 7; Figure 10), and an additional 192 pairs were surveyed on Shediac Island during a ground census in 1998 (C. MacKinnon, unpublished data).

A ground survey on 5 June, 2000 only identified 41 active Great Blue Heron nests at Inkerman (C. MacKinnon, unpublished data), compared to the 68 we identified on aerial photos taken on 31 May, 2000. The ground survey identified active nests by looking for feces rings around the base of trees. It is possible that the aerial survey enumerated birds

that either were roosting on old nests that were not active in 2000 or more likely were misidentified Black-crowned Night-herons (*Nycticorax nycticorax*). Night-heron nests are smaller and in most cases distinguishable from Great Blue Heron nests. However, on the photos some nests were difficult to assign to species. We did not count Black-crowned Night-heron nests because, like tree-nesting cormorants, they nest at multiple levels within the canopy and are difficult to identify on photos. During the 5 June, 2000 ground survey 480 Black-crowned Night-heron nests were identified (C. MacKinnon, unpublished data).

Smith (1980) lists 13 active Great Blue Heron colonies and one abandoned colony along the Gulf of St. Lawrence coast of New Brunswick. He estimated that these colonies supported approximately 500 pairs of Great Blue Herons. These included several mainland colonies that we would not have surveyed, but also some island colonies that we may have overlooked (e.g. Shediac Island). Despite our incomplete coverage of potential habitat for this species our estimate of nesting pairs is higher than those made by Smith (1980). This suggests that the population may be increasing, although differences in methodology and survey coverage make it difficult to interpret trends at a regional level. At the site level, four of the six Great Blue Heron colonies identified appear to be stable, while Shediac Island is increasing and Cocagne Island is declining (Figure 12).

ACKNOWLEDGEMENTS

Jason Beukens' work with the analysis of aerial photos was invaluable to the completion of the project. We thank Eric Tremblay for providing data from Kouchibouguac National Park, and Roland Chiasson and Sabine Dietz for coordinating ground surveys at Crab Island and providing logistical support and staff for the census at Tern Island, Tabusintac. Colin MacKinnon provided a vast amount of unpublished data for waterbird colonies along this coast, without which the data presented in this report would have been incomplete. Valuable comments on earlier drafts of this report were provided by Greg Robertson, Tony Lock, Colin MacKinnon, and Kevin Davidson.

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Table 1. Location of potential tern nesting sites identified during aerial and ground surveys of the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Date aerial survey	Estimate of individuals from aerial survey	Number of nests from ground count
Shediac Marina	46.226	-64.546	31 May	0	2
Cape Brule, marsh west of	46.233	-64.520	31 May	80-100	0
Cocagne Cove	46.332	-64.571	31 May	20	0
McAlmon Island	46.655	-64.869	31 May	20-30	-[1]
Tern Islands, Kouchibouguac NP	46.777	-64.875	31 May	nc	6911
South of Hay Island	47.222	65.101	31 May	>20	0
Neguac Spit North	47.257	-65.988	31 May	50-100	601
Crab Island	47.292	-64.950	31 May	0	546
Tern Island, Tabusintac	47.328	-64.932	31 May	nc	2607
Grand Anse, unnamed island	47.670	-64.777	31 May	50-60	656
Fox Dens Beach	47.899	-64.500	31 May	nc	678
Caraquet Island	47.825	-64.896	1 June	nc	128
Maisonnette Dune	47.815	-64.965	1 June	nc	180
Bathurst Harbour, unnamed island 3	47.633	-65.648	1 June	>150	240
Heron Island	48.000	-66.163	1 June	nc	0
Dalhousie (Bowater Jetty)	48.072	-66.370	1 June	0	69
			Total colonies	13	11[2]

nc - not counted
[1] Colony not visited during ground surveys
[2] Does not include McAlmon Island

Table 2. Nest counts and clutch sizes of Common Terns at colonies along the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Date	Clutch size (eggs)						Total nests	Total	Mean
				0	1	2	3	4	5	with eggs	eggs	clutch size
Cape Brule, marsh west of	46.233	-64.520	15 June							0		
Shediac Marina	46.226	-64.546	15 June	19	1	1	0	0	0	2	3	1.50
Cocagne Cove	46.332	-64.571	15 June							0		
Tern Islands, Kouchibouguac NP	46.777	-64.875	20 June							6911	-	2.01[1]
South of Hay Island	47.222	65.101	6 June							0		
Neguac Spit North	47.257	-65.988	18 June	200	289	192	110	9	1	601	1044	1.74
Crab Island	47.292	-64.950	20 June	85	100	158	284	3	1	546	1285	2.35
Tern Island, Tabusintac	47.328	-64.932	9 June	557	647	752	1183	24	1	2607	5801	2.23
Grand Anse, unnamed island	47.670	-64.777	19 June	10	63	103	487	3	0	656	1742	2.66
Fox Dens Beach	47.899	-64.500	8 June	432	329	273	76	0	0	678	1103	1.63
Caraquet Island	47.825	-64.896	19 June	2	24	28	73	2	1	128	312	2.44
Maisonnette Dune	47.815	-64.965	19 June	1	23	31	124	2	0	180	465	2.58
Bathurst Harbour, island 3	47.633	-65.648	19 June	6	32	71	130	7	0	240	592	2.47
Dalhousie (Bowater Jetty)	48.072	-66.370	20 June	20	24	22	22	1	0	69	138	2.00
Heron Island	48.000	-66.163	20 June							0		
			Totals	1332	1532	1631	2489	51	4	12618	12485	2.19[2]

[1] Mean clutch size was calculated from 873 randomly selected nests, E. Tremblay, unpublished data
[2] Excluding Tern Islands, Kouchibouguac NP

Table 3: Number of Ring-billed Gull nests censused during aerial and ground surveys of the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	2000			1986 (Lock 1987a)		
			Method[1]	Date	Nests	Method	Date	Nests
Tern Island, Tabusintac	47.328	-64.932	APE	31 May	843	AVE	27-28 May	0
Tracadie Bar	47.533	-64.866	APE	31 May	2109	GC	18 June	115
Grand Anse, unnamed island	47.670	-64.777	GC	19 June	21	AVE	27-28 May	0
Fox Dens Beach	47.899	-64.500	APE GC	31 May 8 June	311[2] 262	AVE	27-28 May	0
Maisonnette Dune	47.815	-64.965	APE	1 June	268	AVE	27-28 May	0
Bathurst Harbour, island 3	47.633	-65.648	GC	19 June	6	GC	11 June	232[3]
Heron Island	48.000	-66.163	APE	1 June	56	AVE	27-28 May	0
Neguac	47.252	-65.000	AVE	31 May	0	GC	24 June	199
Dalhousie	48.072	-66.370	AVE	1 June	0	GC	10 June	727
Belledune	47.906	-65.831	AVE	1 June	0	GC	10 June	261
				Total	3565			1534

[1] APE = aerial photo estimate, AVE = aerial visual estimate, GC = ground count
[2] The ground count estimate was deemed to be the more accurate and was used for Fox Dens Beach
[3] Includes *Bathurst Harbour, islands 1-4* in Atlantic Region Seabird Colony Database, Canadian Wildlife Service, Sackville, NB

Table 4. Clutch size of Ring-billed Gull nests observed during ground counts at colonies along the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Date	Number of nests with						Total nests with eggs	Clutch size	
				0 eggs	1 egg	2 eggs	3 eggs	4 eggs	5 eggs		Mean	S.D.
Grand Anse, unnamed island	47.670	-64.777	19 June	0	6	10	4	0	1	21	2.05	0.95
Fox Dens Beach	47.899	-64.500	8 June	0	26	83	145	4	4	262	2.53	0.75
Bathurst Harbour, island 3	47.633	-65.648	19 June	1	4	2	0	0	0	6	1.33	0.47
			Totals	1	36	95	149	4	5	289	2.46	0.79

Table 5. Estimates, interpreted from aerial photos, of territorial individuals at Great Black-backed Gull and Herring Gull colonies along the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Date	Territorial individuals			
				GBBG	HERG	Unknown[1]	Total
Island off Richibucto	46.688	-64.856	31 May	34			34
Egg Island	47.105	-65.048	31 May	375	199		574
Neguac Spit North	47.257	-64.988	31 May	95	906		1001
Swinging Point	47.284	-64.963	31 May	104	149		253
Crab Island	47.292	-64.950	31 May	37	78		115
Tern Island, Tabusintac[4]	47.328	-64.932	9 June		4		4
Tracadie Bar	47.533	-64.866	31 May	15	158		173
Grande Anse, unnamed island[4]	47.670	-64.777	19 June	5	1		6
Fox Dens Beach	47.899	-64.500	31 May	123	795		918
Maissonette Dune	47.815	-64.965	1 June	93			93
Bathurst Harbour, island 1	47.650	-65.627	1 June			201[2]	201
Bathurst Harbour, island 3	47.633	-65.648	1 June			36[3]	36
Bon Amy Rocks	48.056	-66.347	1 June	29	40		69
			Total	910	2330	237	3477

[1] Gulls could not be speciated because of poor photo quality.
[2] A ground visit on 6 June confirmed that Herring and Great Black-backed Gulls were both present although a ground was not conducted becausegull chicks had already hatched.
[3] A partial ground survey on 19 June identified six Ring-billed Gull, one Herring Gull, and five Great Black-backed Gull nests.
[4] Observed during ground survey for terns.

Table 6. Estimates, interpreted from aerial photos, of apparently occupied nest-sites at Double-crested Cormorant colonies along the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Nesting habitat	Date	Apparently occupied nest-sites
Egg Island	47.105	-65.048	Ground	31 May	974
Clifton	47.734	-65.386	Cliff	1 June	19
Grindstone Point, east of	47.758	-65.339	Cliff	1 June	573
Pokeshaw	47.789	-65.258	Ground	1 June	619
Maissonette Dune	47.815	-64.965	Ground	1 June	10
Heron Island (main colony)	48.000	-66.163	Tree	1 June	461
Heron Island (southeast colony)	48.000	-66.163	Tree	1 June	128
Bon Amy Rocks	48.056	-66.347	Ground	1 June	287
Fleming Island	47.977	-66.183	Tree	1 June	14
New Brandon	47.760	-65.389	Cliff	1 June	619
				Total	3704

Table 7. Estimates, interpreted from aerial photos, of apparently occupied nest-sites at Great Blue Heron colonies along the Gulf of St. Lawrence coast of New Brunswick, 2000

Location	Latitude	Longitude	Date	Apparently occupied nest-sites
Cocagne Island	46.383	-64.583	1 June	41
Bay du Vin	47.089	-65.108	31 May	200
Inkerman	47.669	-64.789	31 May	68*
Baie de Lameque, mainland east	47.764	-64.669	31 May	81
Caraquet Island	47.825	-64.892	1 June	65
Shediac Island	46.266	-64.540	1998	192[1]
			Total	647

* A ground survey at this site only identified 41 nests (C. MacKinnon, unpublished data)
[1] Ground survey, C. MacKinnon, unpublished data

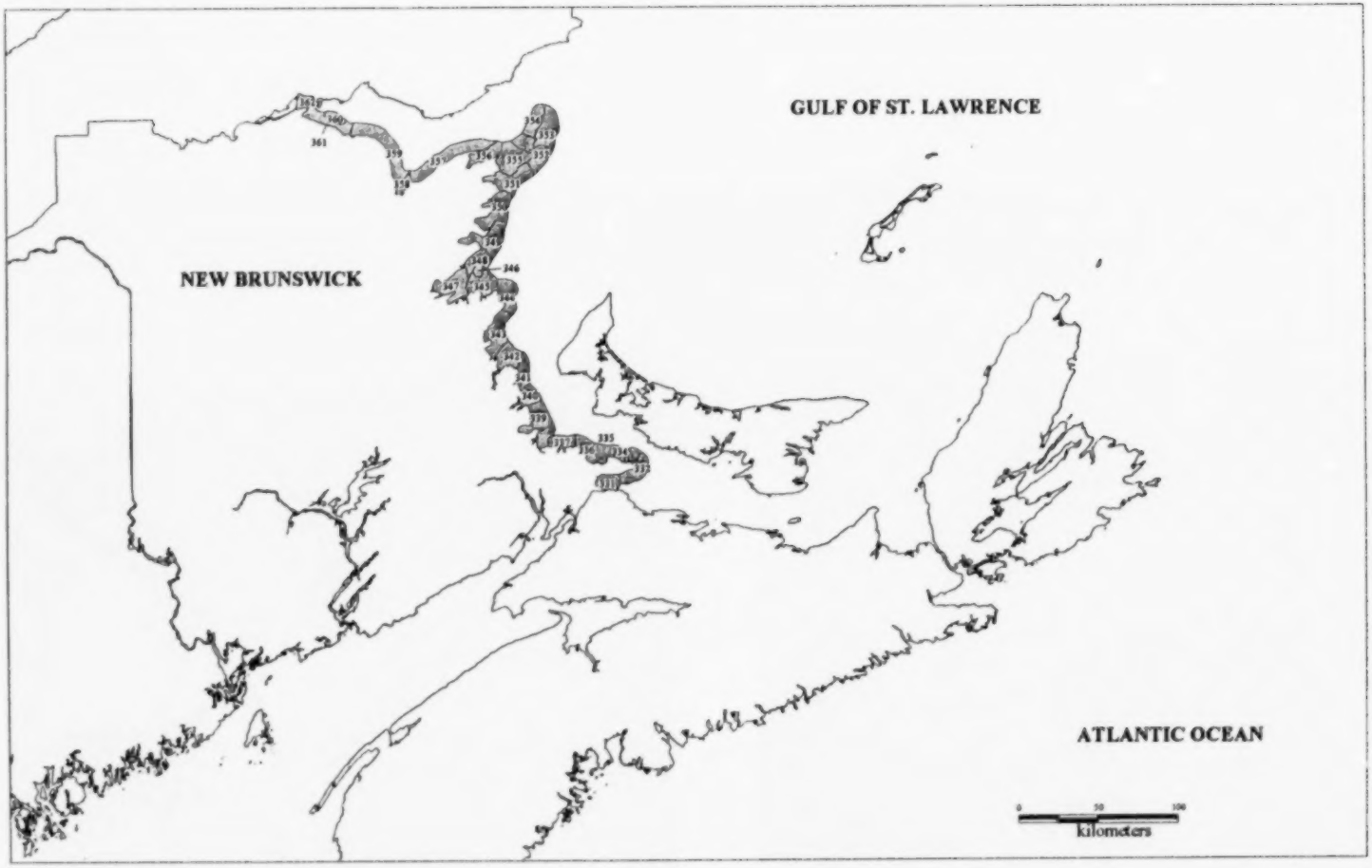
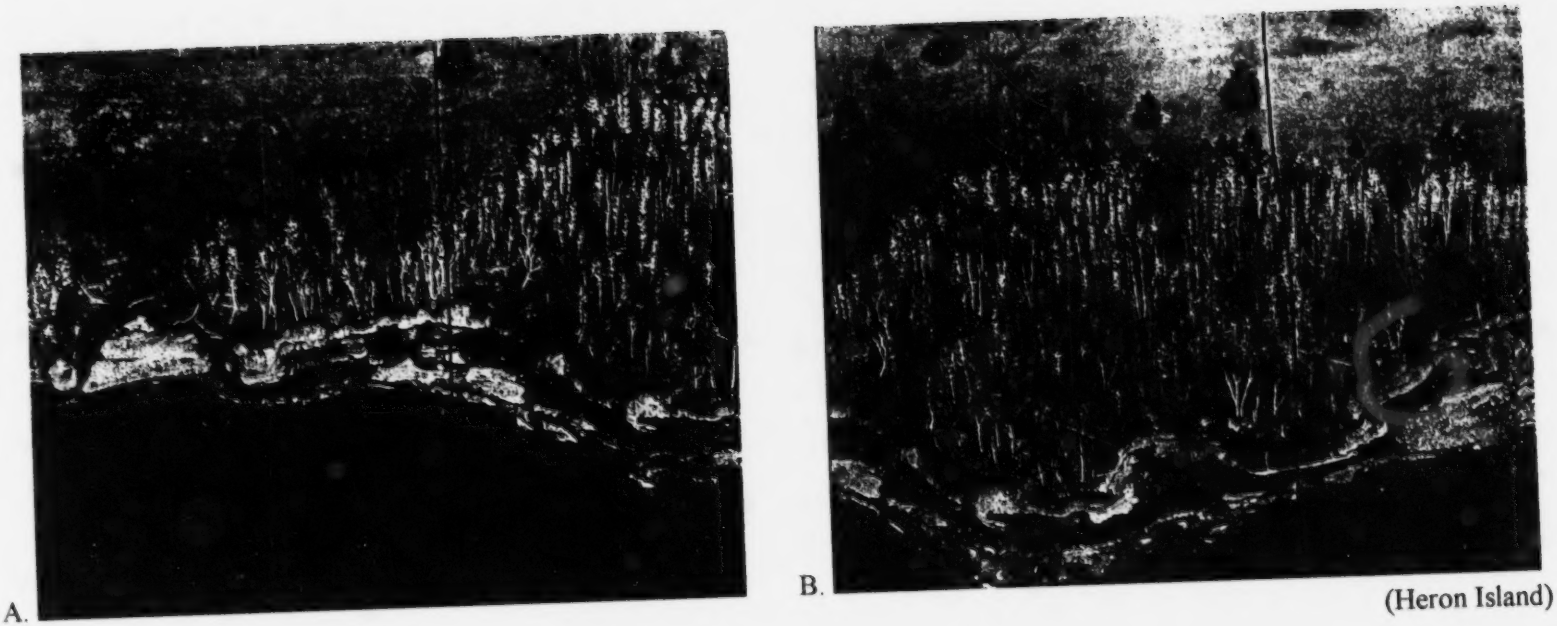
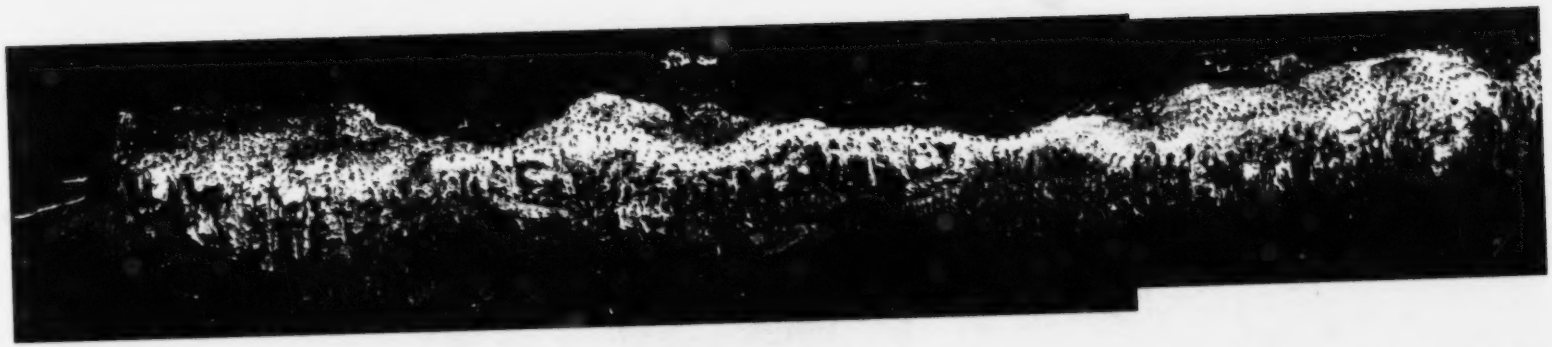


Figure 1. Extent of colonial waterbird surveys conducted along the Gulf of St. Lawrence coast of New Brunswick, 31 May and 1 June, 2000 (CWS Coastal Survey Blocks 331-362 [Hicklin and Barrow 1996])



A. B. (Heron Island)

Figure 2. Line technique used to identify overlap on adjacent photos. The area to the left of the line on image A was counted but the area to the right was not, as it is more clear on image B. The area to the right of the line on image B would not be counted as it is seen more clearly on a third image not shown.



A. B. (Bon Amy Rocks)

Figure 3. Patch technique used to identify overlap on adjacent photos. In Photoshop, image A and image B are "patched" together to create a single image of the colony, with no overlaps.

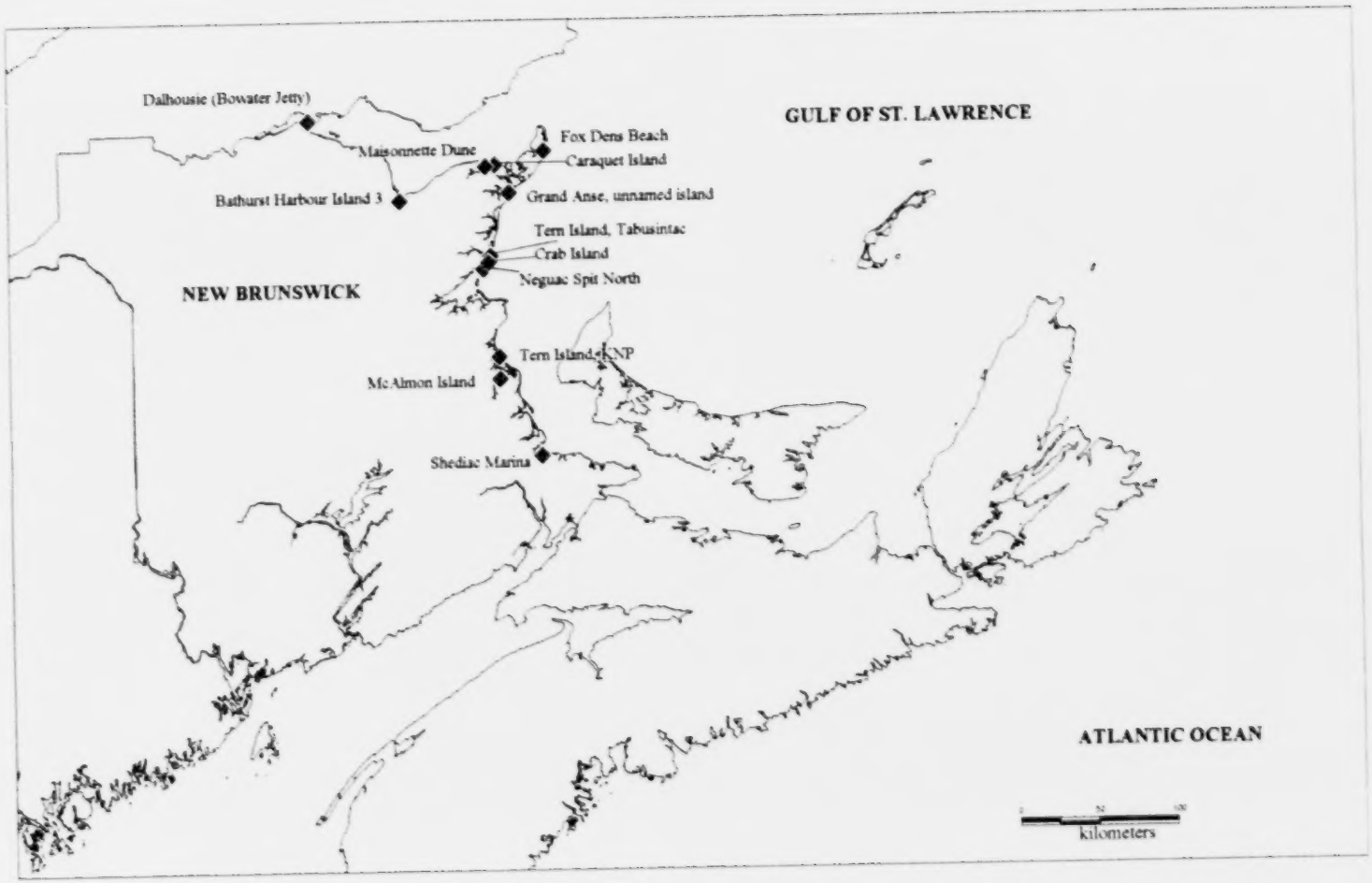


Figure 4. Location of breeding colonies of Common Terns along the Gulf of St. Lawrence coast of New Brunswick, 2000

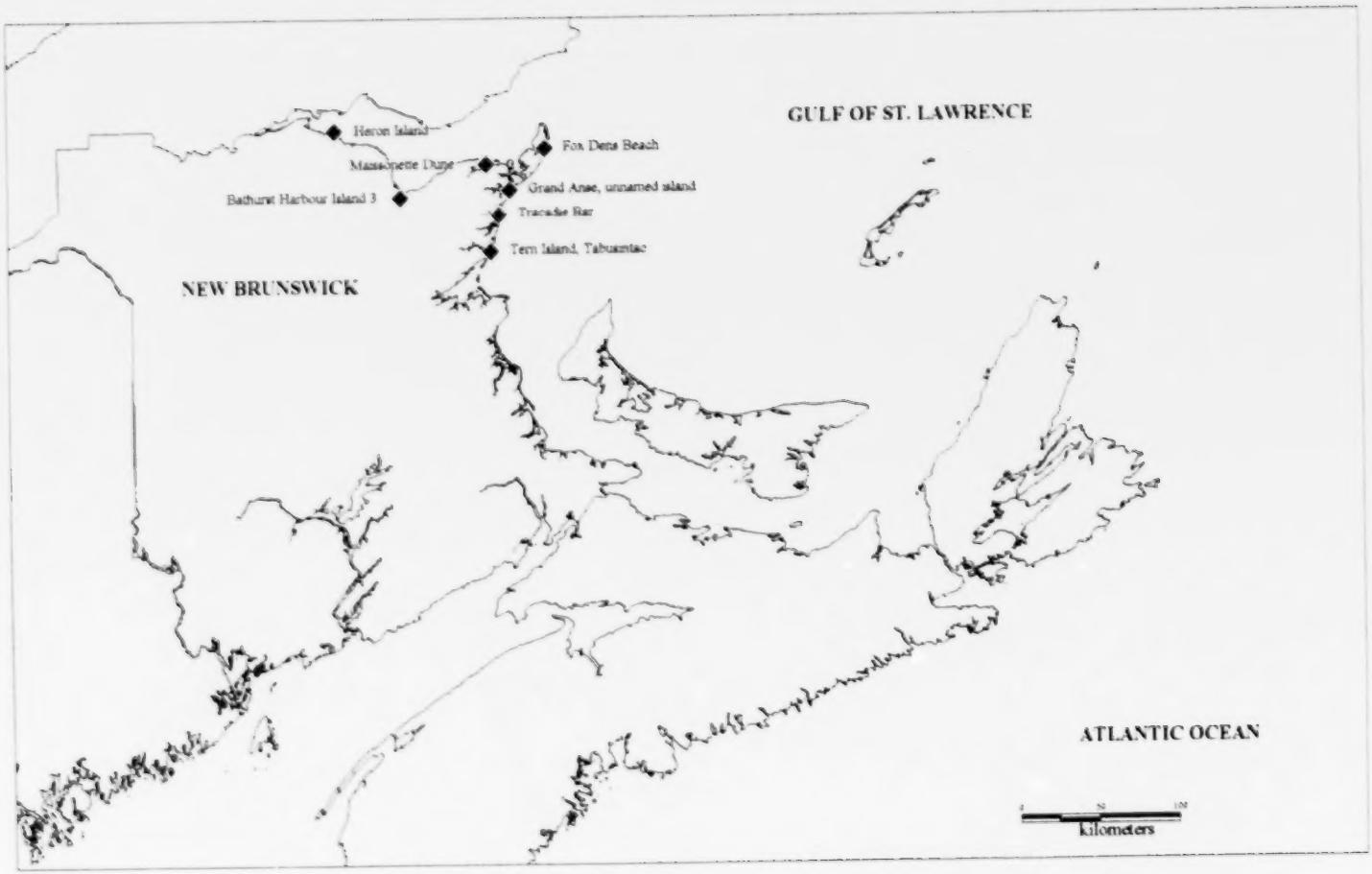


Figure 5: Location of breeding colonies of Ring-billed Gulls along the Gulf of St. Lawrence coast of New Brunswick, 2000

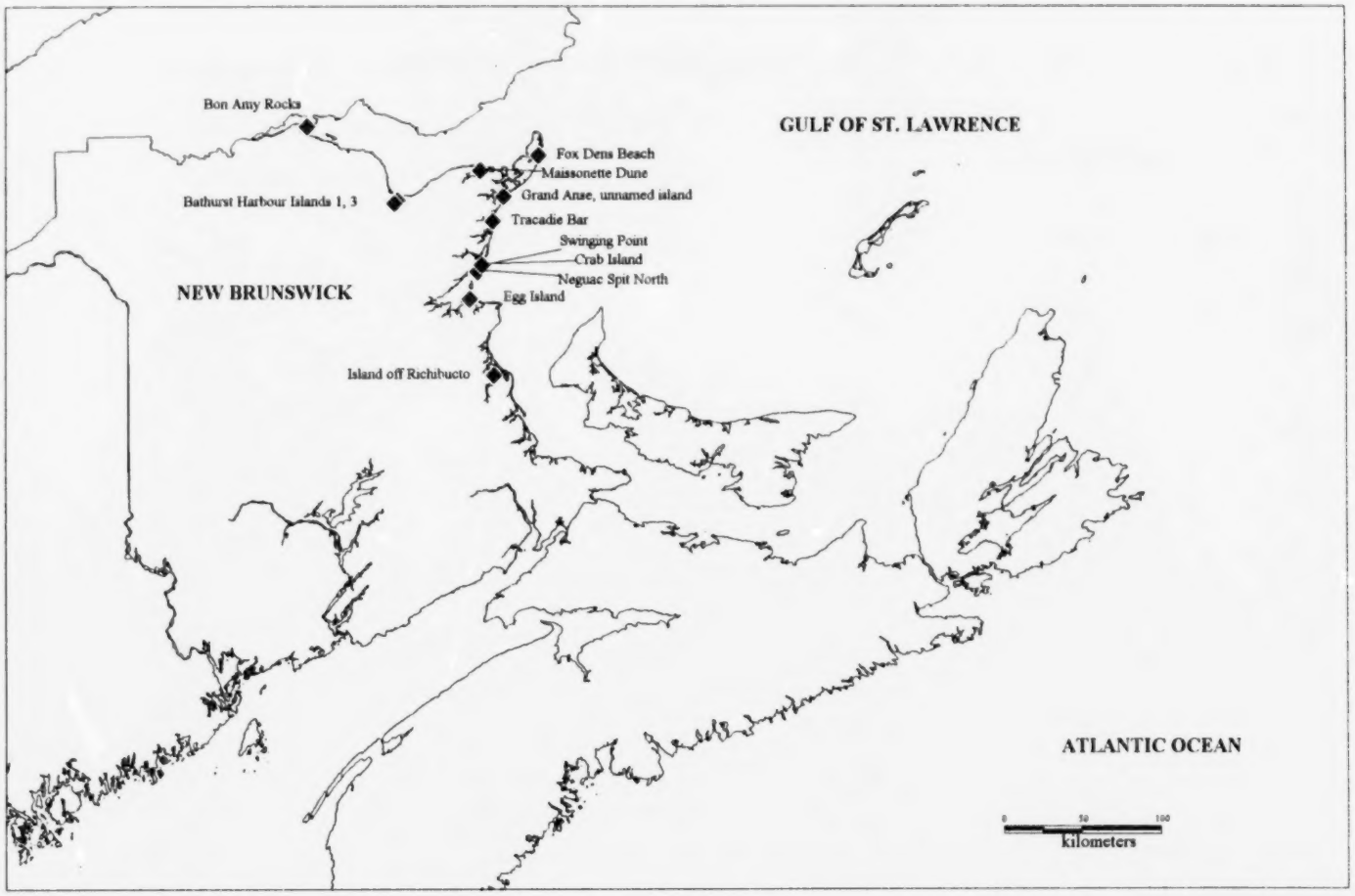


Figure 6: Location of breeding colonies of Great Black-backed Gulls along the Gulf of St. Lawrence coast of New Brunswick, 2000

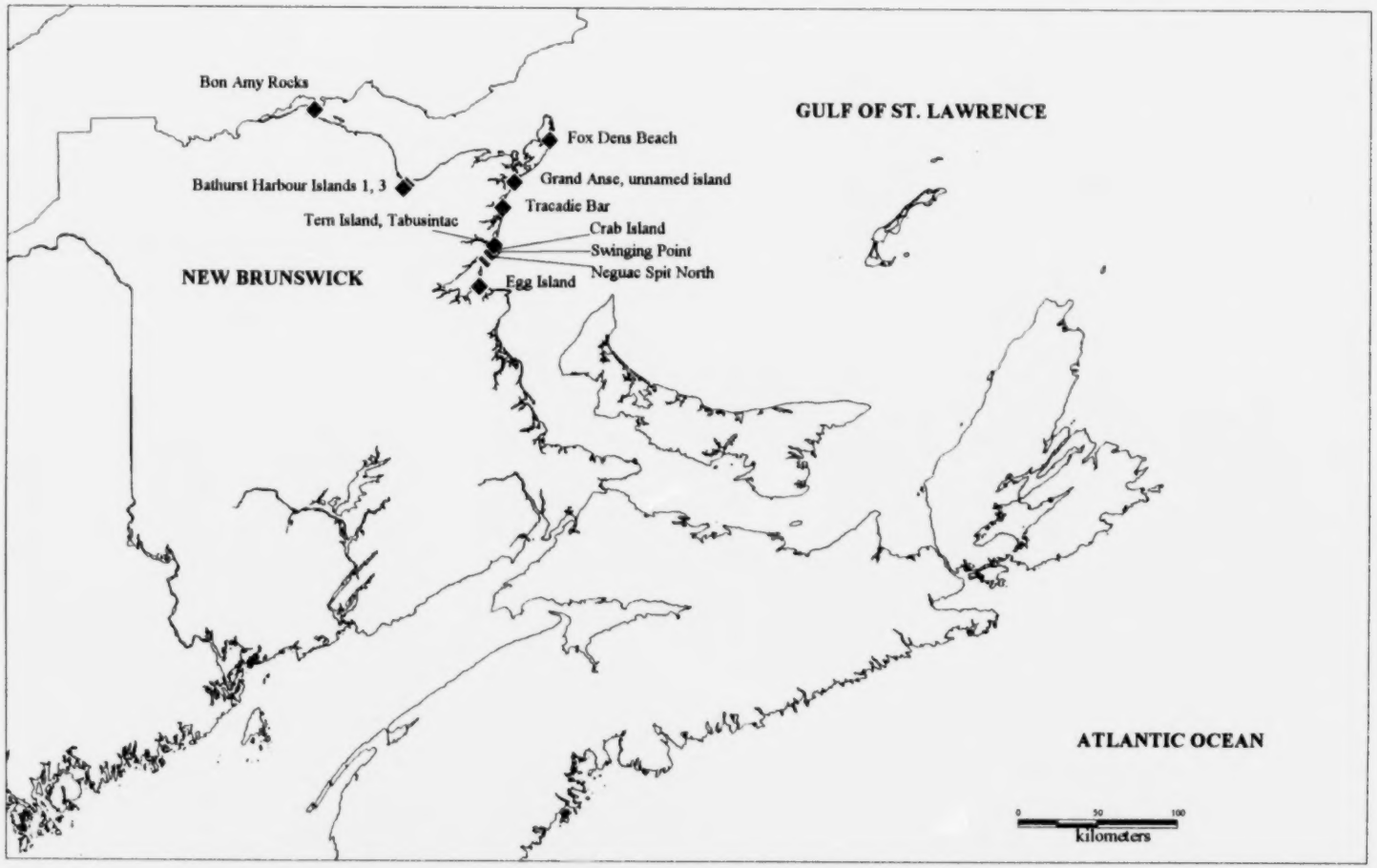


Figure 7: Location of breeding colonies of Herring Gulls along the Gulf of St. Lawrence coast of New Brunswick, 2000

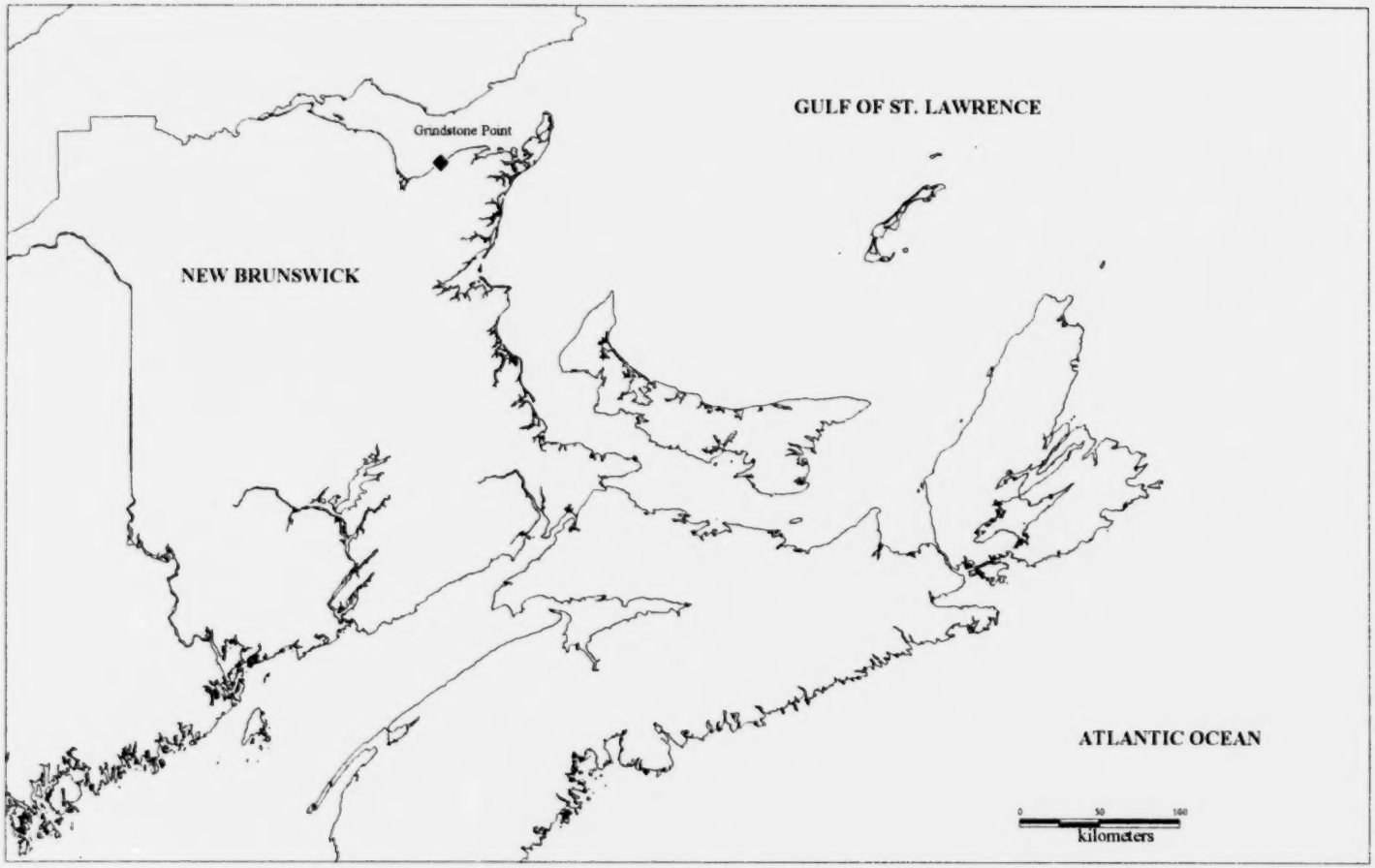


Figure 8: Location of breeding colonies of Black-legged Kittiwakes along the Gulf of St. Lawrence coast of New Brunswick, 2000

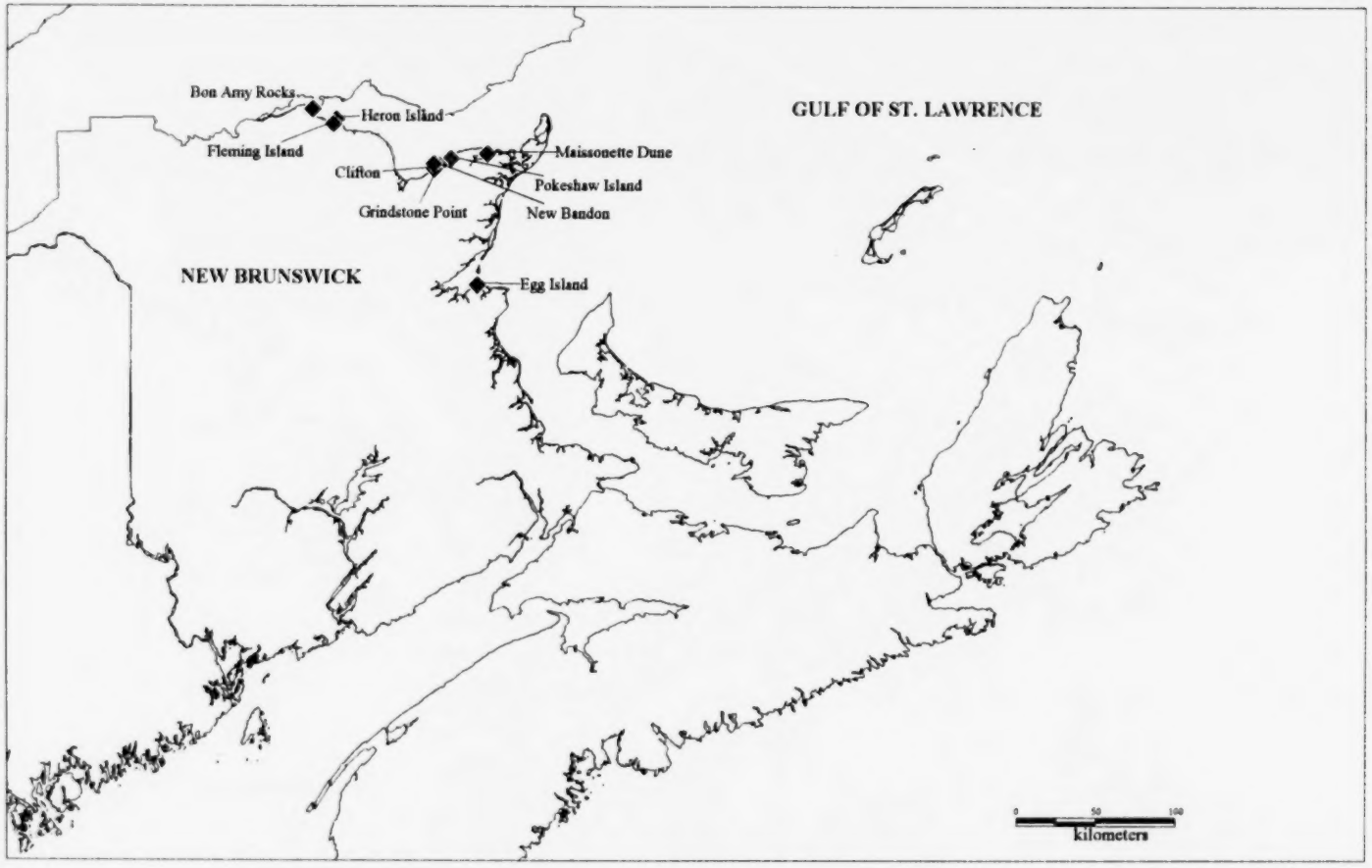


Figure 9: Location of breeding colonies of Double-crested Cormorants along the Gulf of St. Lawrence coast of New Brunswick, 2000

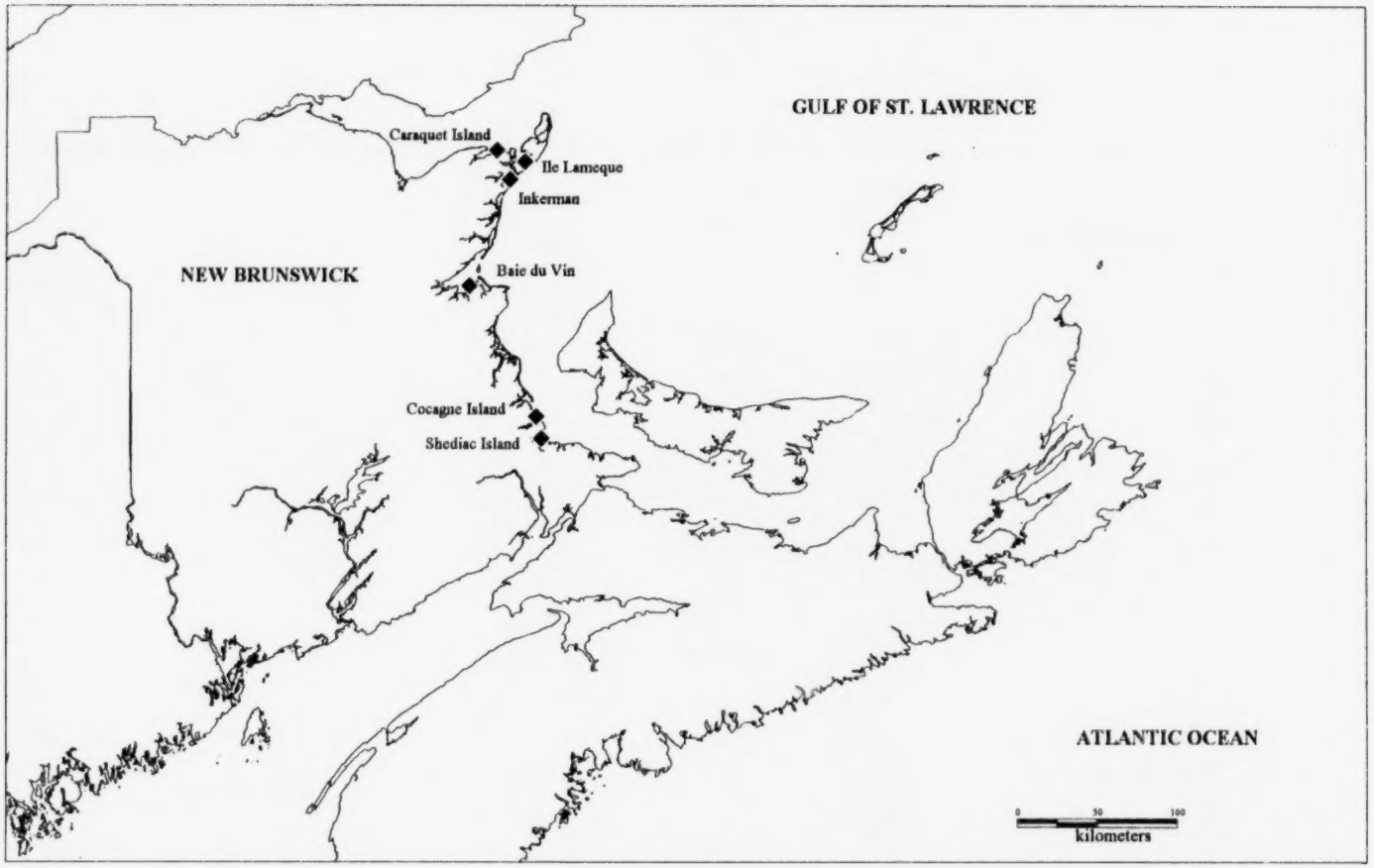


Figure 10: Location of breeding colonies of Great Blue Herons along the Gulf of St. Lawrence coast of New Brunswick, 2000

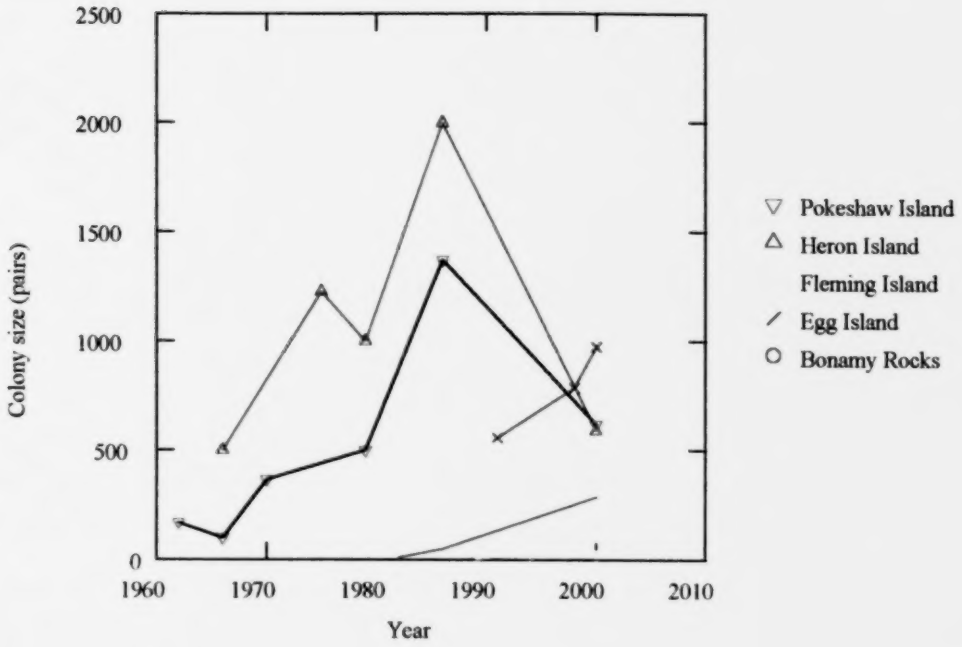


Figure 11. Population trends at five historic Double-crested Cormorant colonies along the Gulf of St. Lawrence coast of New Brunswick.

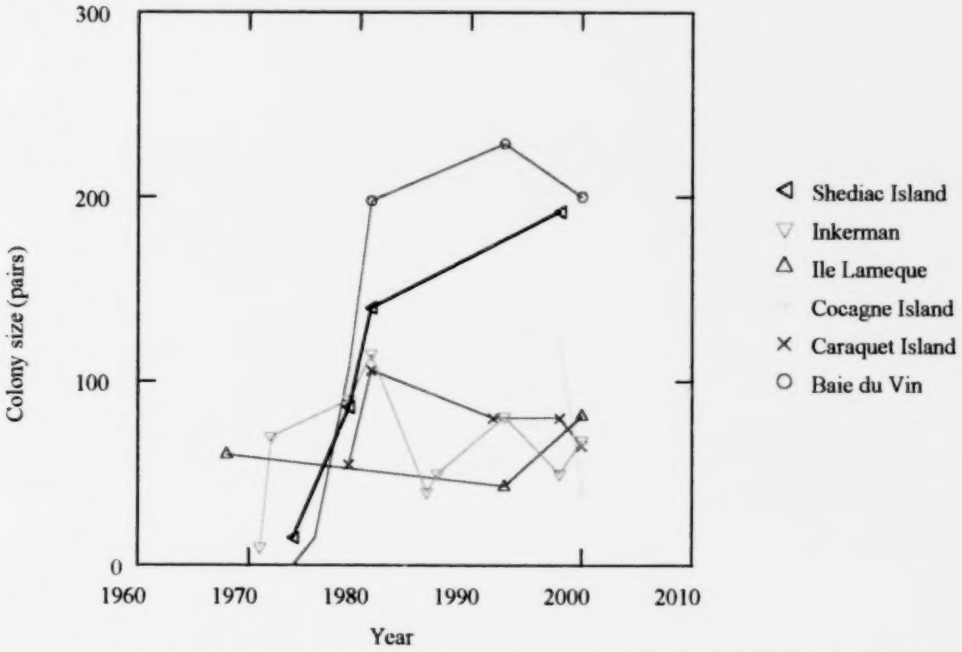


Figure 12. Population trends at six Great Blue Heron colonies along the Gulf of St. Lawrence coast of New Brunswick.

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